



State of Illinois  
Illinois Department of Natural Resources

## *Flood Damage Reduction Study*

# Alexander County

## *Flood of 2011*



Prepared by the  
Illinois Department of  
Natural Resources  
Office of Water Resources  
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## PURPOSE AND AUTHORITY

This report summarizes the results of a flood damage reduction study conducted to investigate the causes and extent of flood damages in Alexander County in the spring of 2011 and to evaluate methods to reduce those flood damages. This study was prepared under the authorization granted to the Illinois Department of Natural Resources under the Flood Control Act of 1945, as amended.

## SCOPE

The scope of this study included the following elements:

- Review of meteorological data to document cause and extent of flood event.
- Collection of highwater marks and other hydraulic information pertaining to the flood event
- Collection of data from other agencies pertinent to this study.
- Conducting detailed first floor and low entry elevation structure surveys for flood prone properties in Alexander County;
- Preparing maps and related drawings;
- Developing computer models to determine structural and content damages of structures in the floodplain;
- Evaluating values of flood prone buildings;
- Determining the costs, benefits and the economic feasibility of potential structural flood control improvements;
- Determining the costs, benefits and the economic feasibility of potential non-structural flood control improvements;
- Preparing a project report.

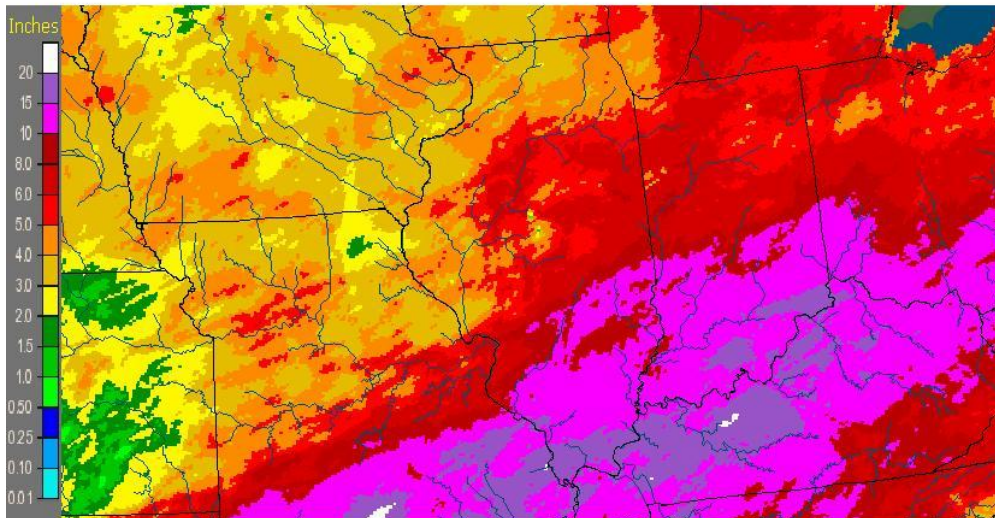
## REVIEW OF METEOROLOGICAL DATA

Record rainfall along the Ohio River Valley, nearly 300 percent of normal precipitation, in conjunction with snowmelt across the upper Midwest, caused record flooding along the Ohio and lower Mississippi Rivers in the spring of 2011. At the confluence of the Ohio and Mississippi Rivers, the above-average water

flow of each river combined ( peak estimated at 2,100,000 cfs) to cause the Ohio River to crest at a record level at Cairo, the Mississippi River to inundate the lower half of Alexander County, and the Corp of Engineers to utilize the Birds Point Floodway for only the second time since its inception.

Heavy rainfall in the month of April, most of it coming in the last 10 days of the month, led to flooding on several other rivers in southern Illinois: Big Muddy River, Cache River, Embarras River, Kaskaskia River, Little Wabash River, Skillet Fork, and the Wabash River. As shown in the NWS precipitation map below (Figure 1), the southern portion of Illinois experienced rainfall amounts for the month of April in the 10-20 inch range. All of that rainfall led to flooding in numerous communities which led to damaged structures, evacuations, and road closures. Thousands of acres of farmland were also flooded.

Illinois: April, 2011 Monthly Observed Precipitation  
Valid at 5/1/2011 1200 UTC- Created 5/3/11 21:37 UTC



**FIGURE 1: APRIL 2011 PRECIPITATION**

## FLOODING IN ALEXANDER COUNTY

Alexander County has various levels of flood protection. The Alexander County border along the Ohio River is entirely protected with federally authorized levees. The Alexander County border along the Mississippi River is partially protected. The North Alexander County Levee is a federally authorized levee protecting the towns of East Cape Girardeau and McClure. Thebes is not protected by a levee and the floodplain has been substantially bought out.

The Len Small Levee begins near Fayville (across from Commerce, MO) at River Mile 39 and ends near River Mile 20. Southern Alexander County from River Mile 20 to River Mile 13 has no protection. The Cairo Levee District and City of

Cairo Levees protect the remaining reach of Alexander County from the Mississippi River.

The Cache River enters Alexander County near Tamms and then flows in a southerly direction until entering the Mississippi River at river Mile 13 where there are no levees. The Upper Cache River was separated from the Lower Cache River when the federally authorized Karnak Levee was constructed around 1950. The Karnak Levee breached in 2002 allowing the Upper Cache River and high flows on the Ohio River to enter the Lower Cache River.

Flooding in Alexander County began in 2011 when the Lower Cache River overflowed its banks caused by three events: 1) heavy rains over the Cache River basin, 2) Ohio River backwater through the Karnak Levee, and 3) the rising Mississippi River backwatering at the Cache cutoff. The communities of Olive Branch, Tamms, and Unity all experienced flooding.



**FIGURE 2: OLIVE BRANCH**

The Mississippi River flooded the southern portion of the county, causing Dogtooth Island to be completely inundated, and flooding out the small communities of Miller City and Willard. On May 2 the Len Small levee breached and overtopped at several locations. A high water mark set by OWR personnel was approximately 4.85 ft above the ground in Willard. In Olive Branch, over 50 homes were flooded. High water marks set by OWR personnel were approximately 3 ft above the ground.



**FIGURE 3: SOUTHERN ALEXANDER COUNTY**

In Cairo, the high water on the Ohio River caused seepage under the levee and created a large sand boil and a second smaller boil along the northern portion of town near 34<sup>th</sup> St. Along Commercial Street in downtown, several sink holes formed necessitating the closure of the street. A mandatory evacuation order was given for Cairo. The Ohio River gage crested at 61.72 ft, 2.21 ft higher than the previous record.



**FIGURE 4: CAIRO SANDBOIL**

Alexander County thus received floodwaters from three sources: 1) Mississippi backwater along the unprotected reach mostly due to Ohio River flows and the Birds Point Levee, 2) high flows on the Cache River partially caused by high Ohio River stages which pushed water through the breached Karnak Levee, and 3) the Mississippi River as it breached the Len Small Levee partially due to high flows on the Ohio River and the Birds Point Levee.

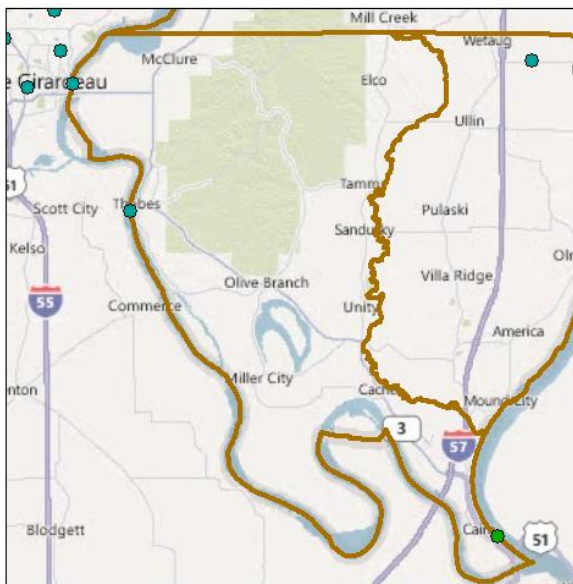
## HIGH WATER ELEVATIONS

The following table shows the peak stages that were recorded at river gages on the Ohio and Mississippi Rivers adjacent to Alexander County.

Gage	Agency	Datum	Peak Stage	Peak Elevation	Date
Ohio River at Cairo	National Weather Service	270.90	61.72	332.62	5/2/2011
Mississippi River at Cape Girardeau, Mo	U.S. Geological Survey	304.65	46.28	350.93	5/3/2011
Mississippi River at Thebes	U.S. Geological Survey	300.00	44.74	344.74	4/29/2011

**TABLE 1**

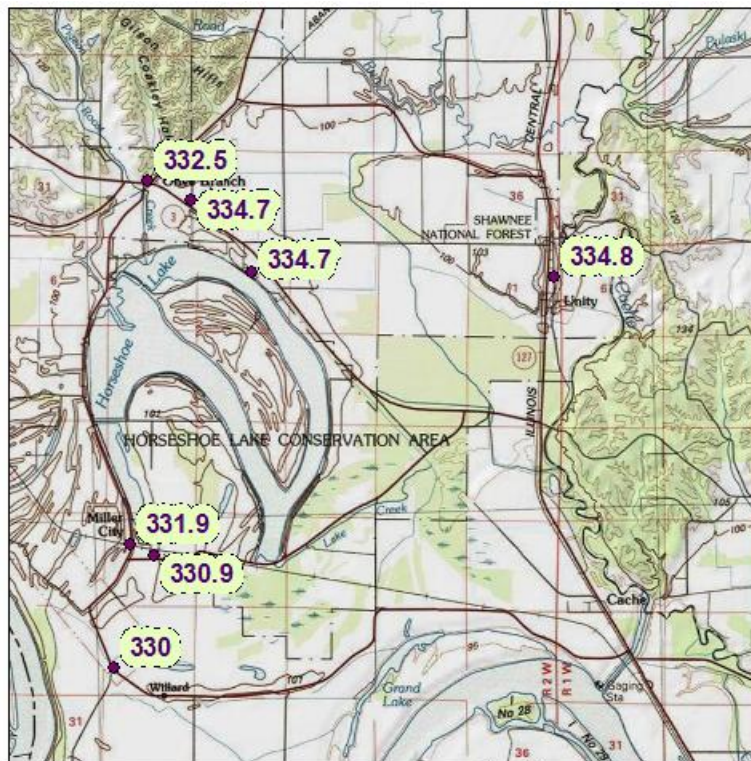
The following figure shows the locations of the river stage gages that are adjacent to Alexander County.



**FIGURE 5: RIVER GAGE LOCATIONS IN ALEXANDER COUNTY**



The following figure shows the locations of high water marks set by OWR immediately after the flood crested.



**FIGURE 6: HIGH WATER ELEVATIONS**

## BIRD'S POINT TO NEW MADRID FLOODWAY OPERATIONS

The description of the operations of the Bird's Point to New Madrid floodway is found in the report "2011 MR&T Flood Report" by Mississippi River Commission. The following is an excerpt from that report.

*On April 21, the Cairo gage reached the moderate flood stage of 50 feet. Bill Frederick, the MRC meteorologist, informed the commission staff that the National Weather Service expected a frontal system to become stationary over the Ohio, middle Mississippi and Arkansas valleys through April 27, with daily rounds of moderate to heavy rains anticipated. Based on the current stages and expected precipitation, NWS models suggested more than a 10-foot rise in the river on the Cairo gage, with a crest exceeding 61 feet on May 4. The commission engineers recognized that if this forecast materialized, the river stages would be in the range that might require the activation of the Birds Point-New Madrid floodway. The Mississippi Valley Division activated its Emergency Operations Center while the commission staff disseminated preprepared technical information papers to the commission members,*

*Corps of Engineers leaders, elected officials and key stakeholders that provided the historical context of the Birds Point-New Madrid floodway and how the MR&T project conveys the project design flood. By April 25, the river rapidly climbed past 55 feet on the Cairo gage and continued to rise. Col. Vernie Reichling, the Memphis District Commander, ordered his crews to load the pump barges with the necessary explosives to activate the floodway. The commission began making arrangements to mobilize for a flyover of southeast Missouri, southern Illinois and western Kentucky and Tennessee and setting up meetings with key stakeholders in the multi-state region. The following day, Maj. Gen. Walsh ordered the movement of the barges to Hickman Harbor and movement of the land-based crews to the floodway. On April 26, Maj. Gen. Peabody directed that the Cumberland and Tennessee River reservoirs reduce outflows to nearly zero to hold water back from Kentucky and Barkley lakes.*

*On April 27, the river surpassed 58 feet on the Cairo gage. The MRC meteorologist notified the commission that he expected the torrential rains of the past week to end for a period of two to three days. The storms during that period dropped in excess of eight inches of precipitation at Tiptonville, Tenn., nine inches at Cairo, 10 inches at New Madrid, 11 at Poplar Bluff, Mo. and Paducah, Ky., and 13 at Greenville, Mo. Taking advantage of the break in the weather, the commission conducted an over flight of the impacted areas. The commission witnessed widespread rainwater and backwater flooding over the Little River drainage area and St. John's Bayou in Missouri and proceeded to the Birds Point- New Madrid floodway. The commission observed high water against the riverside of the frontline levee for its entire length and obtained a clear aerial view of the fuse plug levee section. Severe backwater flooding was evident at the lower end of the floodway, as was rainwater flooding in the upper end. The flight proceeded to Kentucky and Barkley lakes. From the air, the commission noted that lake levels were extremely high and that LRD water managers were doing all that they could do to hold back water to keep stages on the Cairo gage from rising even more rapidly than they actually were. On the return trip, the commission flew over Cairo. Floodwaters had turned the city into a virtual island with only a narrow neck of land along Illinois Route 3 remaining as an evacuation route. The commission ended the trip by flying the length of the Commerce to Birds Point levee to view the extent of flooding on the Mississippi River above Cairo. That same day, the commission and Col. Reichling attended an intense public meeting at East Prairie, Mo., located just west of the floodway on the landside of the setback levee. U.S. Congresswoman Jo Ann Emerson (MO-8) hosted the meeting. Missouri Lt. Governor Peter Kinder and Thomas Shulte, U.S. Senator Roy Blunt's Chief of Staff attended the meeting, as did more than 50 members of the public.*

*Most in attendance opposed the activation of the floodway, with the integrity of the setback levee being the overriding concern. Following the public meeting, the commission traveled to the frontline levee and received an on-the-levee briefing from Memphis District and ERDC personnel preparing the site for potential activation. Dry conditions over the afflicted area on April 28-29 allowed for a brief period of guarded optimism that the water management practices might preclude activation of the floodway. LRD water managers began storing water in Kentucky and Barkley lakes and the rate of rise in the river at the Cairo gage slowed considerably and hovered around 59 feet, just shy of the record stage of 59.51 reached in 1937. Despite this, the commission and Memphis District continued preparations.*

*On April 28, the survey and hired labor crews located, uncovered and prepared all access wells on the frontline levee in the event activation of the floodway became necessary. Commission and district personnel also reported to the U.S. Courthouse in Cape Girardeau, Mo., after a federal judge indicated he would hear testimony on a temporary restraining order filed by the State of Missouri to prevent use of the floodway. The court denied the order on April 29, as did the 8<sup>th</sup> Circuit appellate court on April 30 and the U.S. Supreme Court on May 1.*

*On April 30, Maj. Gen. Walsh established OPERATION WATERSHED as the river continued its slow rise on the Cairo gage, reaching 59.1 at 6:00 a.m. with a forecasted crest of 60.5 on May 3. Even though the rate of ascent has slowed, the tremendous pressure from the swollen river continued its assault on the levee system in the vicinity.*

*Three “mega boils” discovered near the floodwall in Cairo—the largest boils ever witnessed by experienced geotechnical engineers—caused great concern for the integrity of the Cairo floodwall and led the Corps to advise the city to consider issuing an evacuation order.*

*Memphis District personnel also provided a dire engineering assessment of conditions at the mainline levee along the Kentucky and Tennessee borders with the Mississippi, particularly the Hickman and Reelfoot-Obion sectors, as numerous boils that were piping material continued to develop despite intense flood fighting efforts. The grave assessment of stress on the system was compounded by the latest weather reports that called for a frontal system to become stationary along the Ohio River valley through May 2 that would produce up to 7.5 inches of rain. The commission and its engineers, along with personnel from LRD, conducted another aerial assessment of the afflicted areas along southeast Missouri, southern Illinois and western Kentucky and Tennessee.*

*Maj. Gen. Peabody initiated stabilization of the pools at Kentucky and Barkley lakes to conserve storage for this final rain event. Pool levels approached 370 feet — close to the all-time record.*

*The additional localized rainfall on April 30 caused a spike in flood levels, pushing the river past the previous 1937 record on the Cairo gage in the early hours of May 1. Later that morning Col. Reichling briefed the commission at the Cape Girardeau Airport regarding floodway activation. After explaining the conditions on the river and the levee system flanking it were deteriorating rapidly, Col. Reichling expressed his view that floodway activation was no longer a matter of “if” but “when” and recommended the commission allow him to move to hour minus 3 in the Birds Point-New Madrid operating plan, which equated to moving the barges into place, pumping explosives into the pipes and holding. Maj. Gen. Walsh took the recommendation under advisement and traveled with the commission to Cairo to examine conditions and flood fight efforts at the beleaguered city.*

*By the early afternoon, additional heavy rains continued to push river stages higher. The NWS predicted another three to five inches of rain over the following 24 hours. The Memphis District water control office indicated that the river would surpass 60 feet on the Cairo gage within hours and that the storage capacities at Kentucky and Barkley lakes were predicted to reach their limits. Systems analyses provided by the district also showed rapid deterioration at the Cairo, Hickman, Reelfoot-Obion and Caruthersville sectors. All ten sectors in the Memphis District had reached, or were on the cusp of reaching, phase II flood fight activities. Armed with this knowledge, Maj. Gen. Walsh approved Col. Reichling’s recommendation to move to hour minus 3, proceeded to notify the governors and congressional delegations from Missouri and Illinois of his decision and, along with the commission, held a joint press conference with Missouri Governor Jay Nixon at 6:00 p.m. at Birds Point to notify the media and public.*

*The commission established its operations center aboard the Motor Vessel MISSISSIPPI on the night of May 1. That evening, the commission learned that intense overnight storms, accompanied by severe lightning, prevented the task force responsible for preparing the floodway for possible activation from making any headway toward hour minus 3 in the operating plan. The MRC meteorologist informed the commission that more localized rainfall than expected fell overnight and that another one to four inches was expected over the following 24 hours.*

*At 6:00 a.m. the river reached 60.97 on the Cairo gage with a forecasted crest of 63 feet on May 5. Col. Reichling, however, informed the commission in the morning that the task force remained optimistic that it could still fulfill its objective.*

*Throughout the day levee/floodwall conditions continued to deteriorate at Cairo, Hickman, Fulton County and Caruthersville as the high water levels exerted unprecedented pressure on the system. Despite continued rains, wind and cold temperatures, the task force continued to race the rapidly rising river and prepared the floodway for activation.*

*Maj. Gen. Walsh began notifying elected officials from Missouri and Illinois that he intended to approve operation of the floodway once the task force completed its mission. Maj. Gen. Peabody did the same with the governors of Kentucky and Indiana and the Memphis District notified elected officials in Tennessee and all other stakeholders. At 5:00 p.m. the commission held a second joint news conference with Governor Nixon to make public Maj. Gen. Walsh's decision to operate the floodway.*

*At 10:00 p.m., with the river at the Cairo gage reading 61.72, Walsh and the commission members gave the order to activate the floodway.*

*Within an hour the river, which had been rising at a rapid clip up to the point of floodway activation, had dropped by one-half a foot on the Cairo gage. By 11:00 a.m. on May 3, the reading was 60.32 feet. The commission remained in New Madrid to observe the opening of Inflow/Outflow Crevasse No. 2 at the lower end of the floodway. Immediately afterwards, the commission conducted an aerial inspection of the floodway and other afflicted sectors aboard a Blackhawk helicopter.*

The operations criteria for the Bird's Point to New Madrid floodway has changed over time as summarized here.

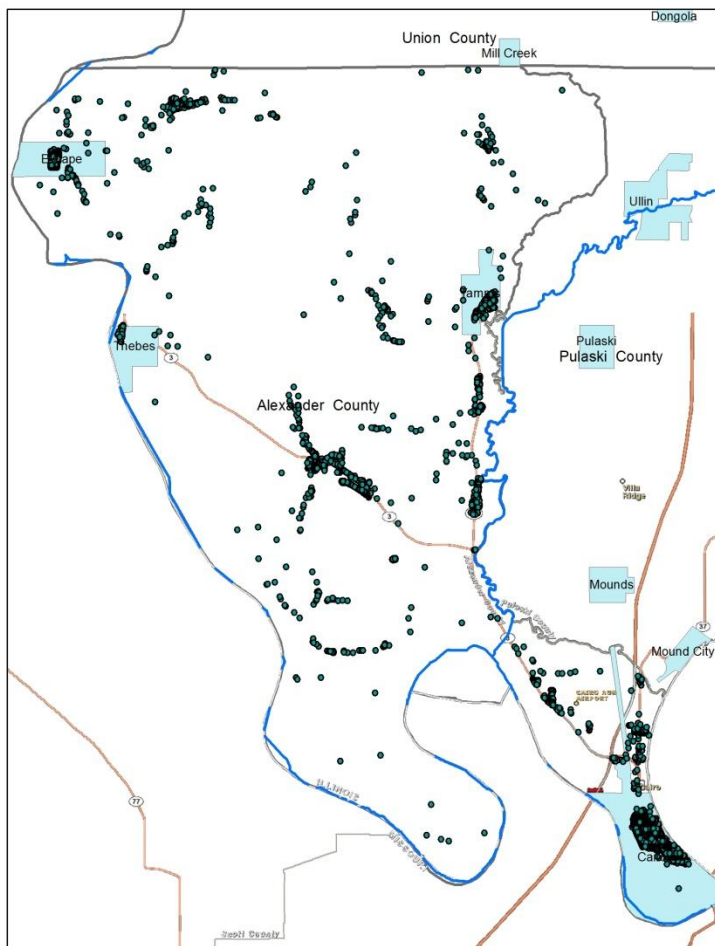
1. The 1928 Jadwin Plan placed the top elevation of the Bird's Point Levee at a stage of 55 feet on the Cairo gage. (325.9)
2. In the 1937 flood, operation of the floodway was authorized when the Cairo gage reached a stage of 58 feet. (328.9)
3. The 1965 Flood Control Act authorized operation of the floodway when the Cairo gage reached a stage of 58 feet and was predicted to exceed a stage of 60 feet (330.9)
4. In 1983, the Mississippi River Commission developed a more detailed plan:
  - a. 56 feet – Tow with necessary equipment would depart the Ensley Engineer Yard.
  - b. 59 feet – Preparation of the inflow crevasse would begin.
  - c. 60 feet – Preparation of the inflow crevasse would be completed.
  - d. Prior to 61 feet – Crevassing of the levee would begin. (331.9)



5. In 2011, the 1983 operation plan was further modified to trigger operation of the floodway when the Cairo gage was at 61 feet (331.9) and forecast to continue rising. The forecast was for 63.0 feet. (333.9)

## RESIDENTIAL AND COMMERCIAL STRUCTURAL FLOOD DAMAGES IN ALEXANDER COUNTY, ILLINOIS

OWR surveyed the first floor and low entry elevations of 674 structures located in Alexander County as shown in Figure 7. The 409 structures surveyed in and around the Olive Branch area were used for this damage analysis. Direct flood damages for the structures were calculated using the OWR program “Damages”: The following is a list of the input requirements for the program and the source of that data:



**FIGURE 7: SURVEYED STRUCTURES**

- First Floor Elevation: obtained by OWR field survey
- Low Water Entry Elevation: obtained by OWR field survey
- Structure Type: Determined in field by OWR surveyors
- Structure Value: Most of the structure values were based on assessed values provided by Southern Illinois University (SIU) which acquired data from Alexander County. For structures that did not have values supplied by SIU an average value of similar type structures in the same area was used.
- Content Values: Contents values for residential units were assumed to be 50% of current structure value per the Apartment and Condominium Personal Property Cost Guide by E.H. Boeckh published by Insurance Company of Illinois. Contents values for commercial structures were estimated as 90% of the structure value
- Water Elevation: the values obtained for the high water marks were used
- Depth-Damage Curves: Federal Insurance Administration (HAZMUS model curves) were used for residential structures and data from the Corps of Engineers was used for commercial structures.

Estimates of damages were made for the following scenarios:

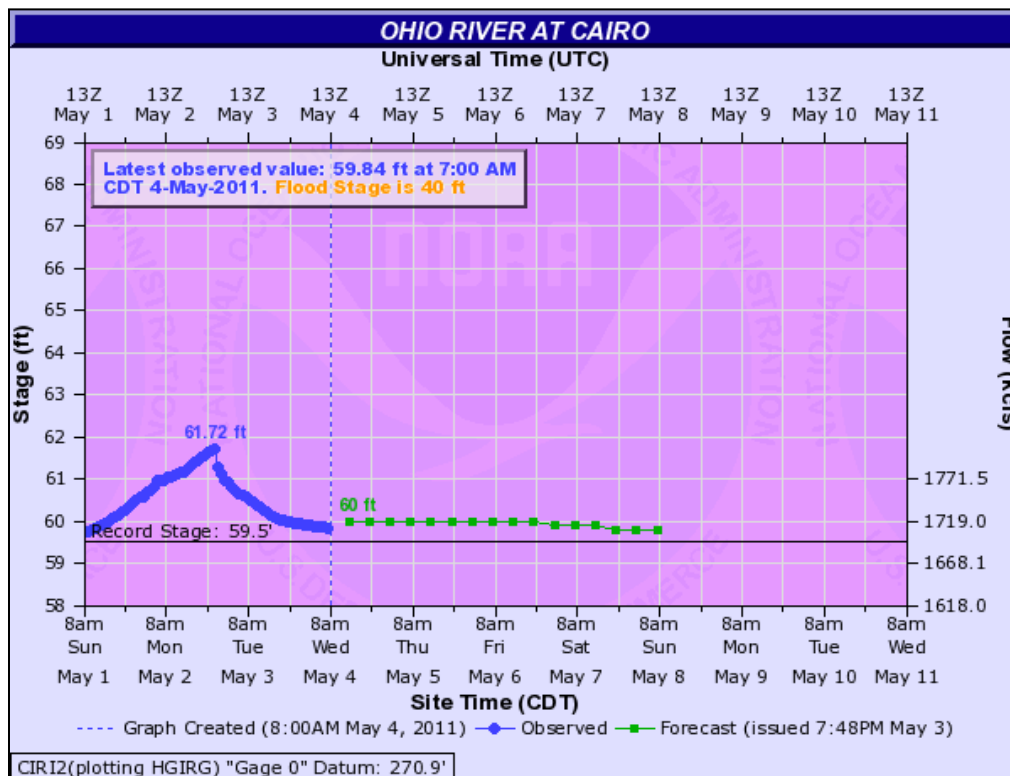
- Highest inundation level based on recorded high water marks
- Inundation level one foot less than highest value
- Inundation level two feet less than highest value.

The results of these analyses are shown in the following table. The 15% indirect damage accounts for flood damage costs associated with such items as barricading flooded roads, additional emergency personnel operations, roadway clean-up after the flood, etc.

	May 2011 HWM Flood Elevation	1 Ft Lower	2 Ft Lower
No. of Structures Damaged	193	152	121
Structure & Content Damage	\$1,886,514	\$1,399,709	\$933,403
Indirect Damages (15%)	\$282,977	\$209,956	\$140,010
Total Damages	\$2,169,491	\$1,609,665	\$1,073,413

**TABLE 2**

Table 2 demonstrates the reduction in structural and content damages if the peak stage in Alexander County had been 2 feet less than what was actually experienced, and that 72 fewer structure would have been flooded with a reduction in the total flood damage of \$1,100,000. Figure 8 shows the immediate impacts of the utilization of the Bird's Point-New Madrid Floodway. After the Birds Point Levee was crevassed late on May 2, 2011, the Cairo gage began a rapid descent to a stage of 60 feet by May 4; a fall of 1.72 feet. The Cairo gage dropped 0.5 feet during the first hour of operation. Based on the predicted stage of 63 feet, operation of the Birds Point to New Madrid Floodway had the potential to reduce flood stages along the Lower Mississippi River in Alexander County by 3 feet. If the floodway had been activated prior to a stage of 61 feet, millions of dollars in flood damages could have been avoided, including the damage to the Len Small Levee, excessive seepage in Cairo, and direct flood damages in unprotected Alexander County. Figure 9 shows the structures damaged by first floor flooding.



**FIGURE 8: OHIO RIVER AT CAIRO HYDROGRAPH**



FIGURE 9: FLOOD DAMAGE MODEL RESULTS

## AGRICULTURAL DAMAGES

According to the United States Department of Agriculture-Farm Service Agency for Alexander County, 19,848 acres of farmland was not planted due to the flooding and approximately 1,821 acres that were planted and then failed due to the flood. (See Appendix I) The Len Small Levee protects approximately 17,000 acres of the 25,000 total acres of farmland in Alexander County. From the U.S. Army Corps of Engineers Project Information Report for the Len Small levee, the estimated annual damages prevented by the Len Small Levee would be \$1.701 million. Section 11, Economics, of the Corps Project Information Report is included in this document as Appendix D.

## MAJOR REHABILITATION NEEDS FOR ALEXANDER COUNTY INFRASTRUCTURE

### LEN SMALL LEVEE REPAIRS

Four breaches occurred in the Len Small levee on May 2, 2011. The Len Small Levee District performed repairs on the three smaller breaches during the summer and fall of 2011. The fourth and largest breach was partially repaired by the district, and the St. Louis Corps estimates \$5 million to complete those repairs, with a benefit to cost ratio of 1.47. (See Appendix D)

### CAIRO PUMP STATIONS

The U.S. Army Corps of Engineers has identified approximately \$3,600,000 of required repairs to six pump stations providing interior drainage protection to the City of Cairo and portions of Alexander County that are within the Mississippi River and Tributaries flood reduction system. Details of the pump station repairs are shown in Appendix B. Based on the General Design Memorandum No. 101 – Phase 1, Flood Control Improvements, City of Cairo, August 1972 by Corps of Engineers the pump stations at 10<sup>th</sup> Street, 28<sup>th</sup> Street, 38<sup>th</sup> Street and 22<sup>nd</sup> Street provide \$444,400 of average annual flood control benefits. While these benefits are in terms of 1973 economic values the same benefits will be assumed for current conditions. To convert the average annual values to an initial value, an interest rate of 4.125% over a 25 year return period will be used. This includes an expectation that the pumps will have to be totally replaced in 25 years. The capacities of the pumps at Goosepond and Cottonwood Slough have been added to the pumping capacity of the four pumps identified above to derive a total system capacity of 382 cfs. The \$444,400 average annual benefits were prorated by pump station capacity, divided by the



number of pumps in each station and then converted to an initial cost as shown in the following table.

Pump Station	Total Station Capacity (cfs)	Number of Pumps	Net Average Annual Benefits assigned to Pump Station	Net Average Annual Benefits Assigned to Each Pump	Capitalized Value of Average Annual Benefits Assigned to Each Pump
10th Street	65	5	\$75,617.80	\$15,123.56	\$232,902.83
28th Street	65	5	\$75,617.80	\$15,123.56	\$232,902.83
38th Street	55	2	\$63,984.29	\$31,992.15	\$492,679.06
22nd Street	37	1	\$43,043.98	\$43,043.98	\$662,877.28
Goosepond	110	3	\$127,968.59	\$42,656.20	\$656,905.41
Cottonwood Slough	50	2	\$58,167.54	\$29,083.77	\$447,890.05
	382		\$444,400.00		

TABLE 3

The “Capitalized Value of Average Annual Benefits Assigned to Each Pump” shown in Table 3 is the upper limit of funds that can be spent on a pump, including motors, controls, lubricators and any other necessary components so that the benefits to cost ratio is 1.0 or greater. The total benefit/cost ratio for the work proposed by the Corps of Engineers in Appendix B is \$6,851,000/\$3,570,920 which equal 1.92. The value of \$6,851,000 is the present worth of the \$444,400 of average annual benefits based on a capital recovery factor of 15.41771 (25 year life with 4.125% annual interest)

## MISSISSIPPI RIVER LEVEES SYSTEM 1

The Mississippi River Levees System 1 consists of 21.5 miles of levees and floodwalls that are owned and operated by four non-Federal local sponsors: Cairo Drainage District, City of Cairo, Mounds City and City of Mounds. The Corps has identified the Ohio River Levee Seepage Control Project having an estimated construction cost of \$12,000,000 for which the City of Cairo and the Cairo Drainage District are the identified local sponsors. The local sponsors are responsible for acquisition of all lands, easements, rights-of-way and borrow sites for the under seepage project which are shown in Appendix G.

The Mississippi River Levees System 1 is a component of the Mississippi River and Tributaries flood control project, see Appendix H. The authorized repair to the Mississippi River and Tributaries Project has a benefit/cost ratio of 34:1, including non-federal costs, as identified in Appendix E of this document.

## NON-STRUCTURAL ALTERNATIVES

The State of Illinois and local government agencies are investigating the buy-out and relocation of the town of Olive Branch. This could remove over 200 structures from the 100-year floodplain.

## FINDINGS

1. 2011 flood stages exceeded estimated 100-year flood elevations across much of Alexander County as substantiated with high water marks and gage records.
2. The operation of the Bird's Point to New Madrid Floodway has changed from the original Jadwin Plan to the operation plan used in 2011.
3. Flood stages across southern Alexander County were directly affected by the timing of the operation of the Bird's Point to New Madrid Floodway.
4. Improvements in Alexander County are necessary to meet the needs of future flood prevention.
5. Improvements to the Cairo Levee, Cairo Levee District Levee, Cairo Pump Stations, and the Len Small Levee have benefit cost ratios greater than 1.0.

## RECOMMENDATIONS

1. The City of Cairo, Cairo Drainage District and Alexander County pump stations should be improved to handle interior floodwaters. Appendixes B and C demonstrate the scope of the improvements. These pump stations are necessary elements of the federally authorized Mississippi River Levees System 1 project which is a part of the Mississippi River and Tributaries. The benefit/cost ratio for the improvements identified in Appendix B is 1.92:1. The improvements defined in Appendix C should be implemented immediately.
2. The City of Cairo levee should be improved to manage seepage. Appendix A demonstrates the significance of the seepage under the levee. Seepage control measures are required to prevent a future failure of the levee. The levee is a component of the Mississippi Rivers and Tributaries project which has a demonstrated benefit to cost ratio of 34:1.
3. The Cairo Levee District levees should be improved to manage seepage. Appendix A demonstrates the significance of the seepage under the levee. Seepage control measures are required to prevent a future failure of the levee. The levee is a component of the Mississippi Rivers and Tributaries project which has a demonstrated benefit to cost ratio of 34:1.

4. The Len Small levee should be improved to prevent flood damages across southern Alexander County. The demonstrated benefit to cost ratio of these repairs is 1.47:1. (Appendix D)
5. Non-structural alternatives for unprotected Alexander County should be considered.
6. Alexander County and the State of Illinois should continue to advise the U.S. Army Corps of Engineers regarding the implementation of the Birds Point to New Madrid Floodway.

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APPENDIX A

GENERAL DESIGN MEMORANDUM NO. 101- PHASE 1, FLOOD  
CONTROL IMPROVEMENTS, CITY OF CAIRO BY CORPS OF  
ENGINEERS

GENERAL DESIGN MEMORANDUM  
NO. 101 - PHASE I

FLOOD CONTROL IMPROVEMENTS  
CITY OF CAIRO  
ILLINOIS

MEMPHIS DISTRICT, CORPS OF ENGINEERS  
MEMPHIS, TENNESSEE  
AUG 1973

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FLOOD CONTROL IMPROVEMENTS  
CITY OF CAIRO, ILLINOIS

Pertinent Data

Location: Ohio River, Mile 979.

Drainage Area: 961 acres.

Existing Sewer System: Combination storm and sanitary.

Present Pumping Stations and Rated Capacities:

38th Street	55 cfs
28th Street	48 cfs
10th Street	31 cfs
22nd Street	37 cfs*

Gravity Outlets: Three.

Pump Starting River Elevation: 294.0.

Maximum Stage of Record (1937): 332.0.

Longest Period Pumping Required: 83 days.

Recommended Improvements:

28th Street	65-cfs pumping plant
10th Street	65-cfs pumping plant

Cost of Improvements: \$1,989,000.

Benefit-Cost Ratio: 4.5.

LMMED-PP

SUBJECT: General Design Memorandum No. 101, Phase I - Flood Control  
Improvements - City of Cairo, Illinois

9 May 1972  
Revised 16 June 1972  
Revised 10 August 1973

b. Pollution. It is anticipated that the pollution problem caused by the discharge of combined storm and sanitary sewage into the Ohio River will be solved, and the city of Cairo will comply with the orders of the Illinois Sanitary Water Board. By consultation with the engineering firm employed by the city of Cairo, who is studying a plan for meeting these requirements, it has been established that our proposed plan for 65-cfs pumping stations at 10th and 28th Streets will be coordinated with whatever plan they recommend. If the "first flush" concept is accepted by the Illinois Environmental Protection Agency, additional gates and valving changes in the pumping plant design, and possibly additional height of the surge tank to provide the required head for pumping into a holding lagoon, will be required. Detailed plans for coordinating the city's sewer system and pumping plants will be handled in the Phase II report. Consequently, our proposed replacement of pumping plants is not expected to contribute to water pollution problems.

10. Cost Estimates. Table III shows first costs of all work included in the revised plan of improvement. Costs shown are based on March 1972 price levels.

Table III

Project Cost Estimate  
City of Cairo Pumping Stations  
65-cfs Pumping Stations at 10th and 28th Streets

<u>Cost</u> <u>Acct</u> <u>No</u>	<u>Item</u>	<u>Federal</u> <u>Cost</u> <u>\$</u>	<u>Non-Federal</u> <u>Cost</u> <u>\$</u>
01	Lands and Damages		
02	Relocations		12,500
11	Levees and Floodwalls	375,000	3,500
13	Pumping Plants	<u>1,195,000</u>	
	Total Project Cost	1,570,000	16,000
30	Engineering and Design	220,000	2,400
31	Supervision and Administration	<u>179,000</u>	<u>1,600</u>
	Totals	1,969,000	20,000
	TOTAL PROJECT COST		1,989,000

9 May 1972  
Revised 16 June 1972  
Revised 10 August 1973

LMMED-PP

SUBJECT: General Design Memorandum No. 101, Phase I - Flood Control  
Improvements - City of Cairo, Illinois

<u>Annual Charges</u>	<u>Federal Cost</u> \$	<u>Non-Federal Cost</u> \$
Interest (4-7/8%)	96,000	1,000
Amortization (100-year)	800	
Operation and Maintenance		5,000
Major Replacement	600	
Total	97,400	6,000
TOTAL ANNUAL CHARGES		103,400

11. Economics. a. Benefits. The report on economic feasibility of the project indicated that estimated annual flood damages in the city of Cairo without pumping capacity is \$446,900. In view of the present condition of the pumping facilities in Cairo, this condition could be expected to occur during any period of continuous pumping. A failure at 10th Street would cause widespread flooding in the business section of the city, and the capacities of the other two stations would be exceeded. A situation in which no pumping capacity is available is predictable with the presently deteriorated condition of the pumping plants. With effective pumping capacities of either 160 or 130 cfs, residual damages are estimated to be \$2,500, which would result in net benefits from damages prevented of \$444,400. The city of Cairo is in an area designated as eligible for assistance under the Public Works and Economic Development Act of 1965. The increase in project costs and in operation and maintenance under the revised plan of improvement presented in this report results in added benefits from area redevelopment. These annual benefits are estimated at \$15,500 from project first costs and \$600 from annual operation and maintenance. The total estimated annual benefits attributable to the project is then \$460,500.

b. Economic Analysis. Annual charges amount to \$103,400, while annual benefits total \$460,500. Based on comparisons of benefits and costs, the work in the city of Cairo as presented herein would have a benefit-cost ratio of 4.3 with flood control benefits only, and 4.5 with area redevelopment benefits included.

12. Statement of Findings. As District Engineer, Memphis District, Corps of Engineers, I have reviewed and evaluated, in light of the overall public interest, the documents concerning the proposed action, as well as the stated views of other interested agencies and the concerned public, relative to the various practical alternatives in accomplishing the objective of reducing flooding in the city of Cairo, Illinois.

## APPENDIX B

### SUMMARY OF NEEDED REPAIRS AT CAIRO PUMPING STATIONS BY CORPS OF ENGINEERS

The Cairo Pump Station at 28<sup>th</sup> Street is approximately 32 years old and in need of major renovations and/or replacements to both mechanical and electrical systems. The Station is equipped with five electric pump units. The pumps and bearings had to be rebuilt in 1994 after 15 years of service. These rebuilt pumps have been operating approximately 17 years and are approaching the end of their service life. One pump unit does not operate and two of the units have significant vibration. The vibration has limited operation of these units to only an emergency condition with no guarantee of future operation. The pumping station capacity is at 40 percent presently. Of the two pump units presently operating, one is beginning to vibrate indicating the 17 years of wear. The three large and five small sluice gates need rehabilitation due to bent stems and inoperable hoist units. The motorized trash rack is worn out and is in need of replacement. The Motor Control Center (MCC) for the structure is antiquated with components that are no longer manufactured or available and therefore in need of replacement.

Preliminary estimate for rehab on 28th Street is as follows:

Rehab of existing pumps including parts and labor:	\$80000 x 5 = \$400,000.00
Rehab of existing motors including parts and labor:	\$10,000 x 4 = 40,000.00
New Motor Control Center:	\$200000 x 1 = 200,000.00
Rehab Trash Rake:	\$50000 x 1 = 50,000.00
Rehab Big Sluice Gates:	\$100000 x 3 = 300,000.00
Rehab Small Sluice Gates:	\$50000 x 5 = 150,000.00
Miscellaneous Equipment:	\$100,000 x 1= 100,000.00
TOTAL	\$1,240,000.00
CONTINGENCY (15%)	<u>186,000.00</u>
TOTAL CONSTRUCTION COST	\$1,426,000.00
Engineering & Design (15%)	213,900.00
Supervision and Administration (6%)	<u>85,560.00</u>
TOTAL ESTIMATED PROJECT COST	\$1,725,460.00

The 28th Street Pump Station is part of a larger flood damage reduction system (FDRS). Therefore, the importance of repairing/replacing the mechanical and electrical components to ensure reliable operation cannot be over-emphasized. The cost to ensure safe reliable operation of the Pump Station is estimated to be around \$1.75 million. The City of Cairo will be in a pumping situation until the gravity flow gates are raised when Ohio River stages fall to less than 18 on the Cairo gage. Therefore, the reduced capacity at the 28th Street Pumping Station will result in interior flooding from a storm of less intensity than the project design.

The 10<sup>th</sup> Street Pump Station is not used as frequently but is in similar shape. A total upgrade is required on it as well. This will mean rebuilding all the pumps, rehab of all sluice gates, rehab of motorized trash rake, and replacement of the Motor Control Center. If this station is going to be returned to a usable facility, it will also require an amount of support equal to the 28<sup>th</sup> Street Pumping Station (\$1,750,000).

Goose Pond pumping station was in pretty good shape except there was some grease leakage from Farval lubricators. The manual lubricators need to be overhauled or replaced. This will require approximately \$5,000.00.

Cottonwood Slough Pumping Station is one of our older pumping stations and is in poor condition. The controls are ancient and can't be repaired. This station needs new controls in the worst way. The lubricators also need replacing. Estimated cost of new controls and lubricators is \$100,000.00

The city owned pumping stations at 38<sup>th</sup> Street and West 22<sup>st</sup> Street were also examined during the flood damage assessment. The 38<sup>th</sup> Street Pumping Station has 2 storm water pumps and 1 jockey pump. The West 22<sup>st</sup> Street Pumping Station has 1 storm water pump and 1 jockey pump. One of the pumps at 38<sup>th</sup> Street is not being used due to a bad bearing. This pump is in need of an overhaul to replace all bearings. Estimated cost of repair is \$10,000. The pump at West 22<sup>st</sup> Street will not rotate due to a log or object in the impeller. Estimated cost of repair for this station is \$5000.

## APPENDIX C

### CAIRO PUMP STATION INSPECTION NOTES BY OWR

On January 10, 2012 representatives of the Illinois Department of Natural Resources, Office of Water Resources inspected five pump stations in and around the City of Cairo with representatives of the Corps of Engineers and the City of Cairo.

- 1) 10<sup>th</sup> Street Pump Station (City owned and operated): There are five pumps contained within this pump station building. Pump number 1 is the northernmost pump and pump 5 is the southernmost pump. City personnel turned on the pumps one by one starting with pump number 5 and ending with pump number 1. All pumps seemed to be manually functional with the flip of a switch; however, pump number 1 appeared to have a broken shaft and thus was unable to push water up since the impellor was not attached to the shaft. Pump 3 had significant vibrations in the base plate that should be addressed.

The Army Corps of Engineers and the City of Cairo have indicated that this pump station is not used as frequently as the 28<sup>th</sup> street pump station. During this inspection they said that this pump station was built in 1969 and the pumps within the building are the original pumps.

The Army Corps has recommended that all of these pumps be rebuilt to guarantee their usefulness going into the future. However, a local pump repair expert has estimated that each of the motors can be repaired for \$5,000 or less. This would include rewinding the motors and replacing the bearings. No estimate was provided for repairing the pumps.

Recommendation: Repair and/or replace pumps and motors on units 1 and 3

- 2) 28th Street Pump Station (City owned and operated): This pump station is nearly an exact replica of the 10<sup>th</sup> street pump station and therefore the pumps are numbered the same. Pump number 1 is in extremely bad condition and appears to not be salvageable. Pump number 3 had extreme vibration problems and pump number 4 had no connection to the impellor. Pumps 2 and 5 appeared to be in good working order and City personnel and Army Corps personnel indicated that the motor for pump number 2 was rewound during the flood of 2011.

In a brief report, the Army Corps of Engineers has indicated that this pump station is 32 years old. They have said that the pumps and bearings were



rebuilt in 1994 after 15 years of service. They have indicated that these rebuilt pumps are approaching the end of their useful service life. They have concurred with our findings that pump number one is not working properly due to the broken shaft and/or shaft connection. They have told us that two of the pumps have significant vibration problems, which limits their use to emergency situations.

The Army Corps of Engineers has also indicated that the three large and five small sluice gates need to be rehabilitated due to bent stems and inoperable hoist units. They have also indicated that the motorized trash rack is worn out and is in need of replacement. In addition, they have stated that the motor control center (MCC) for the structure is antiquated with components that are no longer manufactured or available and therefore in need of replacement. They have provided a preliminary estimate of cost for the rehab of the 28<sup>th</sup> street pump station of \$1,725,460. They estimate that the cost to rehab the 10<sup>th</sup> street pump station to also be \$1,725,460 since the pump stations are identical.

Recommendations: Repair and/or replace pumps and motors on Units 1, 3 and 4.

- 3) 38<sup>th</sup> Street Pump Station (City owned and operated): There are two main pumps contained within this pump station building along with a smaller “jockey pump” in the sump area. Pump number 1 is the northernmost pump and pump 2 is the southernmost pump. City personnel turned on pump 1 manually and it appeared to be functioning adequately. They did not turn on pump 2 as they said the outlet pipe to this pump is crushed or blocked. The City also indicated that the bearings are bad in pump 2. The City has hired Walden and Associates from St. Louis to run a camcorder through the pipe to determine the exact cause of the blockage of this pipe. The “jockey” pump was turned on and appeared to be in good working order.

In conclusion, it appears that pump number two needs to be rehabilitated and that the pipe blockage needs to be resolved.

Recommendation: Repair and/or replace motor on Unit 2

- 4) 22<sup>nd</sup> Street Pump Station (City owned and operated): There is one main pump contained within this pump station building along with a “jockey” pump in the sump area. This facility was built in 2001 and therefore the equipment is fairly new. City personnel and personnel from the local utility company turned on the jockey pump first and it appeared to be in good

working order. An attempt was then made to turn on the main pump, however this was unsuccessful. It appeared that the circuit breaker kept tripping.

The Army Corps of Engineers stated in their report that they believed something was lodged in the impeller. The City hired a local pump repair company recently and they said there was not anything lodged in the propeller but that the propeller had dropped a few inches and was stuck on the bottom of the pit. All they had to do was raise it and it was working fine at that time. However, it appeared that a wiring issue was tripping the circuit breaker so it was not possible to witness that pump in operation mode.

In conclusion, the City was going to resolve the wiring issue.

Recommendation: Repair and/or replace electric starter control

- 5) Goose Pond Pump Station (County owned and operated): There are three pumps contained within this pump station building. Pump number 1 is the southernmost pump and pump 3 is the northernmost pump. County personnel turned on the pumps one by one starting with pump number 1 and ending with pump number 3. All pumps seemed to be manually functional with the flip of a switch. County personnel indicated that the motor for pump number 3 had been rewound two years ago. County personnel pointed out that the manual lubricators for each pump were not functioning.

The Army Corps of Engineers stated in their report that this pump station is in “pretty good shape except there was some grease leakage from the Farval lubricators”.

In conclusion, the manual lubricators need to be fixed. A local company has indicated that they can easily fix these lubricators.

Recommendation: Repair and/or replacement of lubricators

- 6) Cottonwood Slough Pump Station (County owned and operated): There are two pumps contained within this pump station building. Pump number 1 is the southernmost pump and pump 2 is the northernmost pump. County personnel turned on the pumps one by one starting with pump number 1 and ending with pump number 2. All pumps seemed to be manually functional with the flip of a switch. However, the County Engineer stated that he believes the pumps are too small to handle the

flood events at this location. He stated that due to this capacity problem, during flood events, they have to build a temporary levee through a farm field just north of the pump station and easterly to the highway in order to divert water to the Goose Pond pump station. This happened recently in 2002, 2008 and 2011. County personnel indicated that the manual lubricators for each pump were not functioning at this location either.

The Army Corps of Engineers has pointed out that this is one of the oldest pump stations in the area and they believe the controls all need to be replaced also.



APPENDIX D  
LEN SMALL DRAINAGE AND LEVEE DISTRICT PROJECT  
INFORMATION REPORT

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**PROJECT INFORMATION REPORT  
PL 84-99 REHABILITATION OF DAMAGED  
FLOOD CONTROL WORKS**

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**LEN SMALL LEVEE DISTRICT  
ALEXANDER COUNTY, ILLINOIS**

**MISSISSIPPI RIVER**

**22 November 2011**



## 11. ECONOMICS

a. Economic Analysis Scope. The Len Small Levee District levee (Alexander County, IL), on the left descending bank of the Mississippi River, was damaged by June 2011 flooding. Action is needed to repair the levee damage, thereby reducing future flooding of more than 20,000 total acres (17,000 cropland acres) partially protected by the levee. This levee is open at the downstream end (no high-ground tie-off or ring levee) and therefore provides incomplete protection. The beneficial effects of the levee stem from frequent event water levels flowing into the levee district from the open downstream portion of the levee district. These event water levels are several feet lower than the same event water levels at the upstream leveed portion of the district area. Thus during frequent event flooding, upstream roads and structures experience reduced flooding impacts. If the levee is not repaired, Mississippi River waters will enter the levee district at less than a 50% (2-year) flood frequency. The repaired project will provide a 20% flood (5-year, pre-flood design) level of protection. The current Federal discount rate of 4 percent was used to amortize costs. As required under EP 500-1-1, the period of analysis for this non-Federally constructed agricultural levee is the 5 years, (lesser of 10 years or the protection level provided by the repaired levee). Annual damages, benefits, and costs are summarized in Table 1, below.

Table 1	
Annual damages without project	\$3,171,000
Annual damages with project	1,470,000
Total annual damages prevented (benefits)	\$1,701,000
Crop damage reduction	(113,000)
Structural damage reduction	(15,000)
Location Benefit	(1,573,000)
Total project cost estimate	\$5,169,000
Annualized at 4%, 50-year period	1,161,000
Benefit-to-cost ratio	1.47

b. Benefits. Benefits for repairing the levee were derived by comparing the average annual damages with and without the repair project. The levee partially protects an estimated 20,000 total acres, of which 17,000 acres is agricultural production land. An assumed 40% of the cropland is planted in corn, and 40% is planted in soybeans, and 20% planted in wheat. The Location Benefit listed under the "Location Benefit" category in Table 1 are calculated in Table 4.

(1) Methodology. The undamaged levee provides a 20% frequency (5-year) design level of protection upstream for crops and a 6.7% frequency (15-



year) design level of protection for structures with no tieback in the downstream area. For this reason, the structure damages for the with-project condition are estimated to be 50% lower than without the project (below the 6.7% frequency. The damaged levee provides no protection (flooding will occur with less than a 50% flood (2-year event). The floodplain is primarily flat (with elevation variation of a few feet) across the entire 20,000 acres. Damage reduction benefits accrue to cash crops (corn, soybeans, and wheat), structures, residences, and infrastructure. Farm budget analysis and estimated elevation- acreage data were employed for this benefit category. The damage analysis for structures includes impacts to farmsteads, homes, roads, ditches and utilities. Information from MVS real estate report formed the basis for this categorical damage curve estimation. Table 2 displays project elevation, flood-frequency, acres inundated, categorical damages, and average annual damage calculations for the without-project and the with-project conditions. Table 3 displays the monthly crop budget analysis. This analysis (yielding an annual per acre flood-induced change in income) includes estimates for variable production expenditures, flood-stage exceedance probability, and metrics for replanting and reduced yield assumptions. Table 4 displays the loss of land value associated without a repaired levee. According to the MVS Real Estate Branch, the value of the land outside of the levee is only \$800 per acre, compared to \$2,400 per acre within the levee area. Without proper repairs, the 17,000 crop acres would lose a total of \$27,200,000 in value. This impact is amortized over a 30-year period to reflect the length of a loan.

(2) Distribution of Benefits. There are more than 60 beneficiaries of this levee repair project. No one beneficiary receives more than 25 percent of the project benefits.

(3) Total Value of Property. In accordance with EP 500-1-1 and to insure the applicability and reasonableness of the project (land value exceeds repair costs), the total value of the property protected was determined:

Crop Acreage	(17,000 acres x \$2,400)	\$40,800,000
Other Acreage	(3,000 acres x \$2,400)	7,200,000
Improvements	(60 properties x \$75,000 each)	4,500,000
		\$ 52,500,000

\* Reference: MVS Real Estate Values report (PIR 2011)

(4) Benefits Less Than 5% of Cropland Value. As shown, the benefit per acre is less than the 5 percent maximum allowed.

<u>Crop</u>	<u>Land Value</u>	<u>x 5%</u>	<u>Benefit/Acre</u>
Corn	\$2,400	\$120	\$8
Soybeans	\$2,400	\$120	\$5
Wheat	\$2,400	\$120	\$7
Location	\$2,400	\$120	\$93

\* Benefit per Acre calculation

Annual                      Benefit

<u>Crop</u>	<u>Total Acres</u>	<u>Benefit</u>	<u>per Acre</u>
Corn	5,760	57,628	\$8
Soybeans	5,760	30,955	\$5
Wheat	2,880	24,369	\$7
Location	17,000	1,443,000	\$93

(5) Net Cash Income. As shown, the net cash income per acre exceeds the benefit per acre for corn and soybeans.

<u>Crop</u>	<u>Net Cash Income Per Acre</u>	<u>Benefit/Acre</u>
Corn	\$352	\$8
Soybeans	\$48	\$5
Wheat	\$39	\$7

\*Estimated based on typical production costs, average yields, and current cash prices for the specific crop and region.

c. Cost Data. First cost of the project is computed as follows:

Total Project Construction Cost	\$5,169,000
Federal Cost	4,190,100
Non-Federal Cost (20% x (Cost less PED))	\$978,900

The annual charge for interest and amortization shown below is based on the estimated first cost of the project, a 5-year evaluation period, and a discount rate of 4 percent.

Annual Costs (4 Percent Discount Rate)	
Interest and Amortization	\$5,518,000
Additional Operation and Maintenance	NA
Total Annual Costs	\$1,239,000

d. Analysis Summary. Annual maintenance cost for this portion of the levee is accounted for under the annual maintenance costs for the original levee project. Total annual benefits, total annual costs and the benefit-to-cost ratio are shown below.

Average Annual Benefits	\$1,701,000
Average Annual Costs	1,161,000
Benefit-to-Cost Ratio	1.47: 1

# APPENDIX E

## STATEMENT OF THE MISSISSIPPI RIVER COMMISSION



MISSISSIPPI RIVER COMMISSION  
P.O. BOX 80  
VICKSBURG, MISSISSIPPI 39181-0080

### MISSISSIPPI RIVER COMMISSION VICKSBURG, MISSISSIPPI

August 18, 2011

### STATEMENT OF THE MISSISSIPPI RIVER COMMISSION

Mississippi River and Tributaries (MR&T) Project

#### PRESIDENT and MEMBER

Maj. Gen. Michael J. Walsh  
Commander, Mississippi  
Valley Division  
Vicksburg, Mississippi

#### MEMBERS

Honorable Sam E. Angel  
Civilian  
Lake Village, Arkansas

Honorable R. D. James  
Civilian/Civil Engineer  
New Madrid, Missouri

\*Honorable Wm. Clifford Smith  
Civilian/Civil Engineer  
Houma, Louisiana

Rear Adm. Jonathan W. Bailey  
National Oceanic and  
Atmospheric Administration  
Silver Spring, Maryland

\*Maj. Gen. John W. Peabody  
Commander, Great Lakes &  
Ohio River Division  
Cincinnati, Ohio

\*Brig. Gen. John R. McMahon  
Commander, Northwestern  
Division  
Portland, Oregon

#### SECRETARY

Col. George T. Shepard Jr.  
Vicksburg, Mississippi

#### EXECUTIVE DIRECTOR

Mr. T. Stephen Gambrell  
Vicksburg, Mississippi  
(601) 634-5766

Email: cemvd-ex@usace.army.mil  
Web site: www.mvd.usace.army.mil/mrc

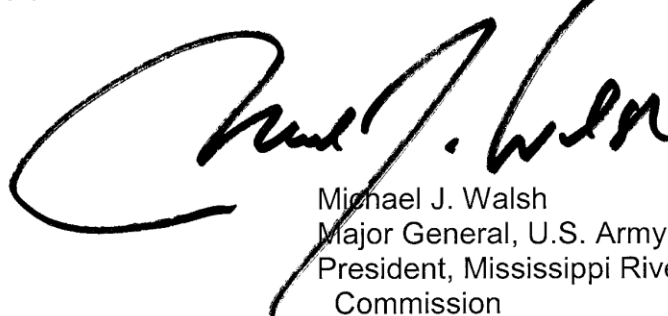
\* designee

*The Mississippi River Commission identifies an emergency system need for \$2 billion to restore damages to the nation's water infrastructure caused by the 2011 flood along the Mississippi River.*

The implementation of a high benefit cost ratio funding strategy for the protection of the nation's economic engine along the Mississippi River and its tributaries is essential.

The President of the MRC approved an investment scenario identifying \$775 million in funding needs immediately to execute a prioritized list of the first 93 projects under current project authorities with a total requirement of \$2 billion to restore the MR&T system to the congressionally-authorized levels and prevent economic devastation in the heartland of America. Without these critical repairs, the 4 million people protected by the MR&T system face greater risk from floods of a lesser magnitude.

The MR&T project has a Federal benefit cost ratio of 34 to 1 to date. Economists estimate that the comprehensive system prevented more than \$110 billion in damages during the 2011 historic flood in the lower area of the watershed.

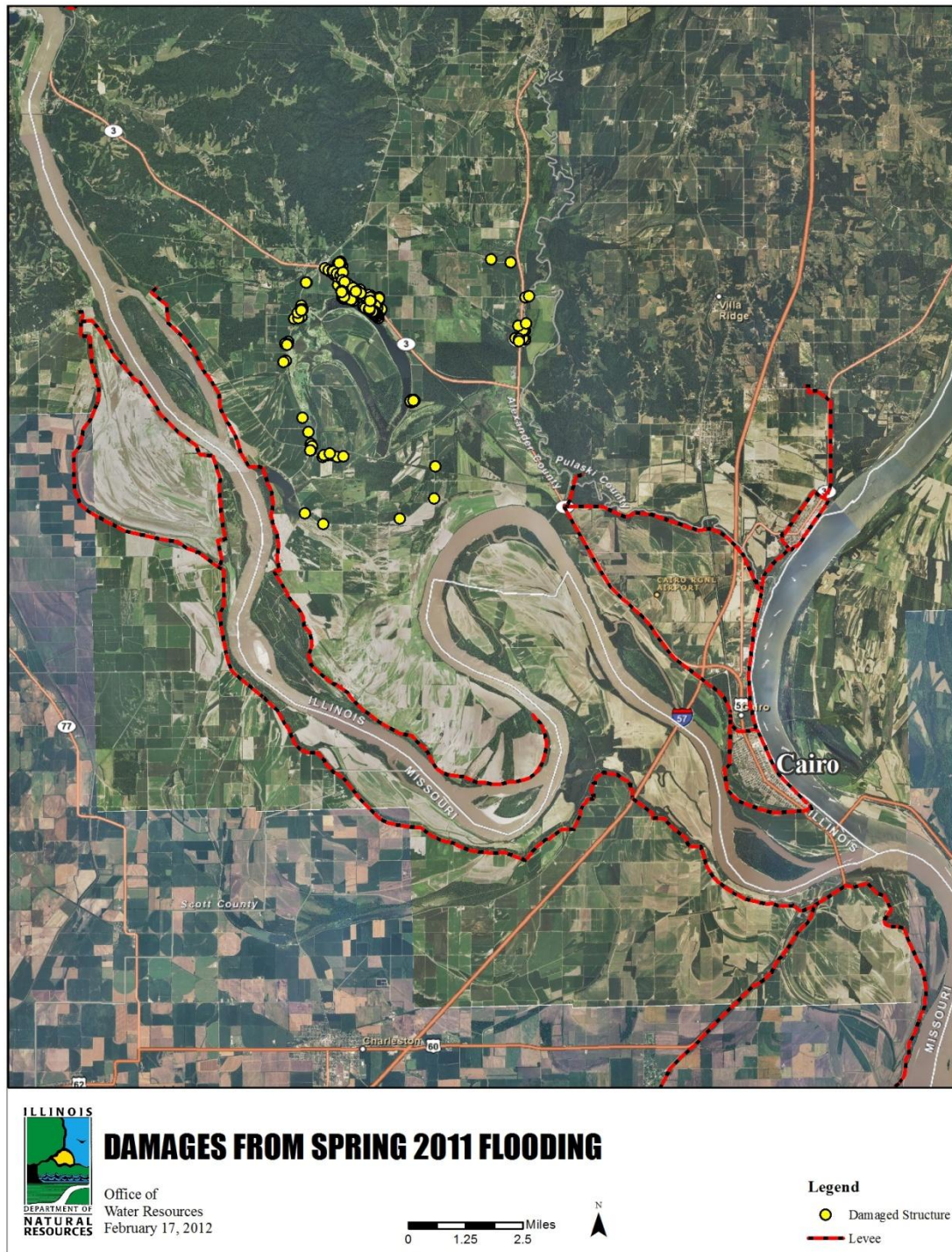


Michael J. Walsh  
Major General, U.S. Army  
President, Mississippi River  
Commission



## APPENDIX F

### ALEXANDER COUNTY MAPPING



## APPENDIX G

### OHIO RIVER LEVEE SEEPAGE CONTROL PROJECT

CEMVM-EC-G

November 10, 2011  
Tatum/4216

MEMORANDUM THRU

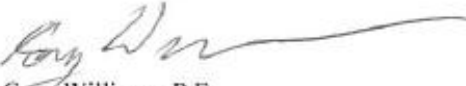
CEMVM-RE

FOR CEMVM-RE

SUBJECT: Right of Way Clearance for Seepage Control Projects at Cairo, Alexander County, Illinois

1. Enclosed are two copies of the Cairo, IL 1:24,000 quad map showing the project location for new relief well, berm, and slurry trench construction for Cairo Ohio River Seepage Control Projects. A set of drawings including aerial photos of the levee, levee baseline and approximate levee ROW boundary is also attached. The proposed relief wells will be installed primarily along the landside toe of the levee. The proposed berms will be located within 250 ft. from the landside toe of the levee. The proposed slurry trench will be installed along the riverside toe of the levee near top bank of the Ohio River. Required right of way limits for the proposed work vary according to the type of seepage control being installed at that location. There will be two additional areas requiring temporary construction easements to repair damage from two large high-energy sand boils that appeared during the flood.
2. The work consists of installing relief wells, seepage berms, a slurry trench, CMP culverts, drop inlets, buried drainage pipes, excavation, grading, and reestablishment of turf to include rough dressing, fertilizing, and seeding, along with environmental protection. The proposed work will be at three locations between baseline stations 6/15+00 to 9/18+00. As much of the work as possible will be performed within the existing ROW limits of the City of Cairo and the Cairo Drainage District; however, due to the extent of the proposed projects, some ROW outside these existing limits will need to be obtained.
3. A copy of your letter to Local Interests should be furnished to the Caruthersville Area Office and this office. It is requested that this right-of-way be acquired to meet scheduled advertise date of 15 June 2012.
4. Contact Regina Kuykendoll-Cash for all charge code questions.
5. If additional information is needed, contact Ben Tatum at 4216.

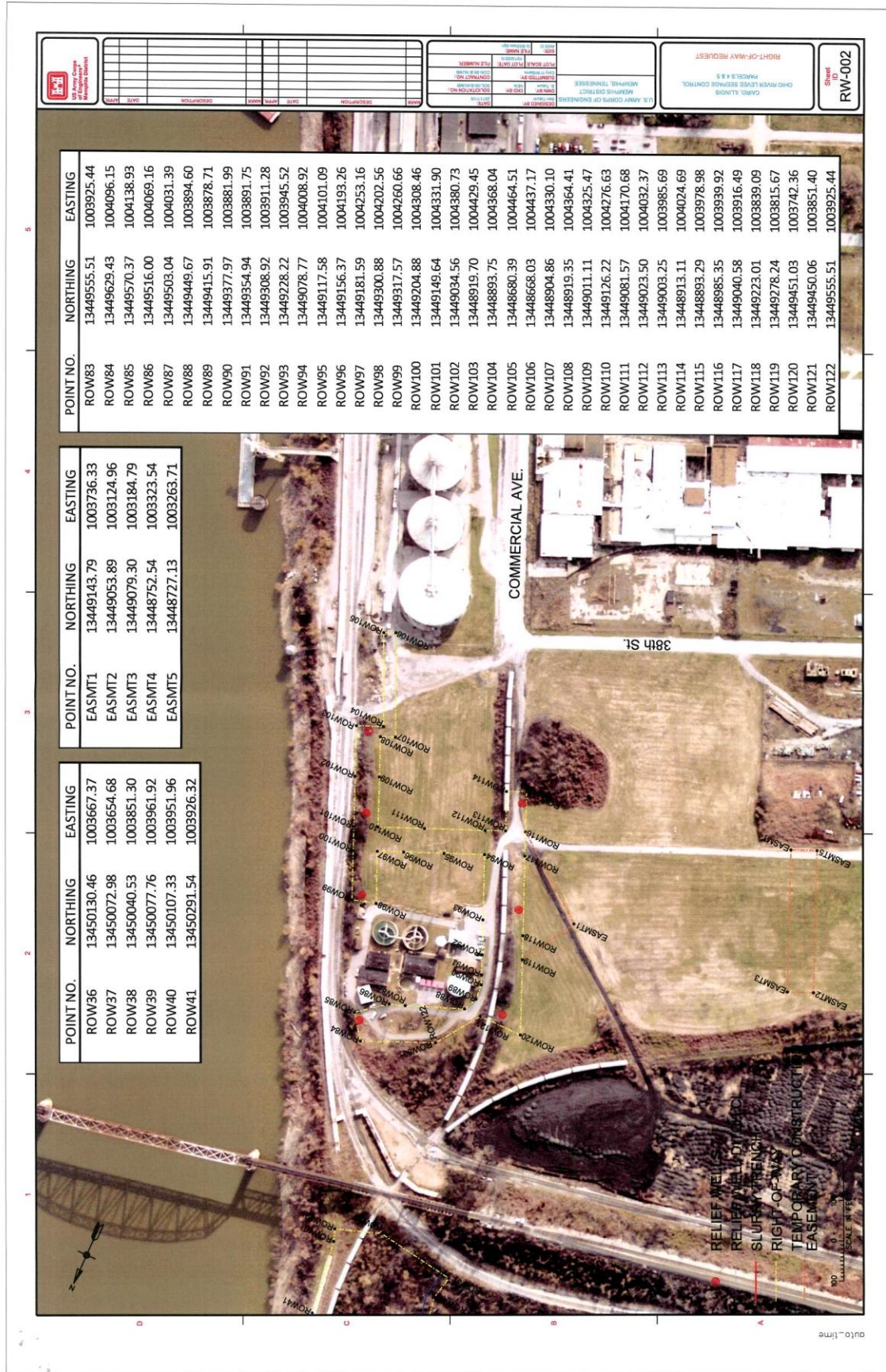
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Cory Williams, P.E.  
Geotechnical Engineering Branch

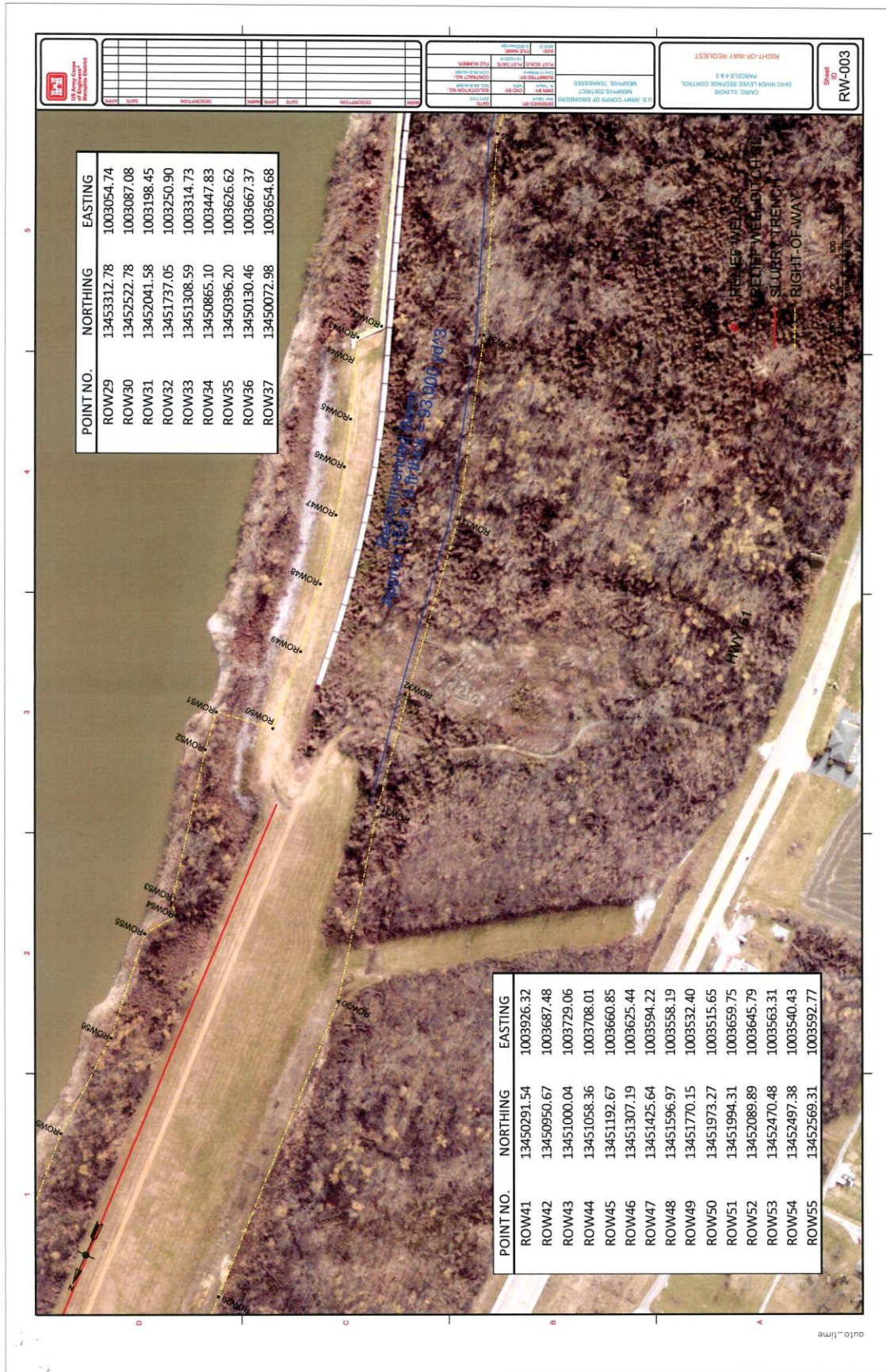




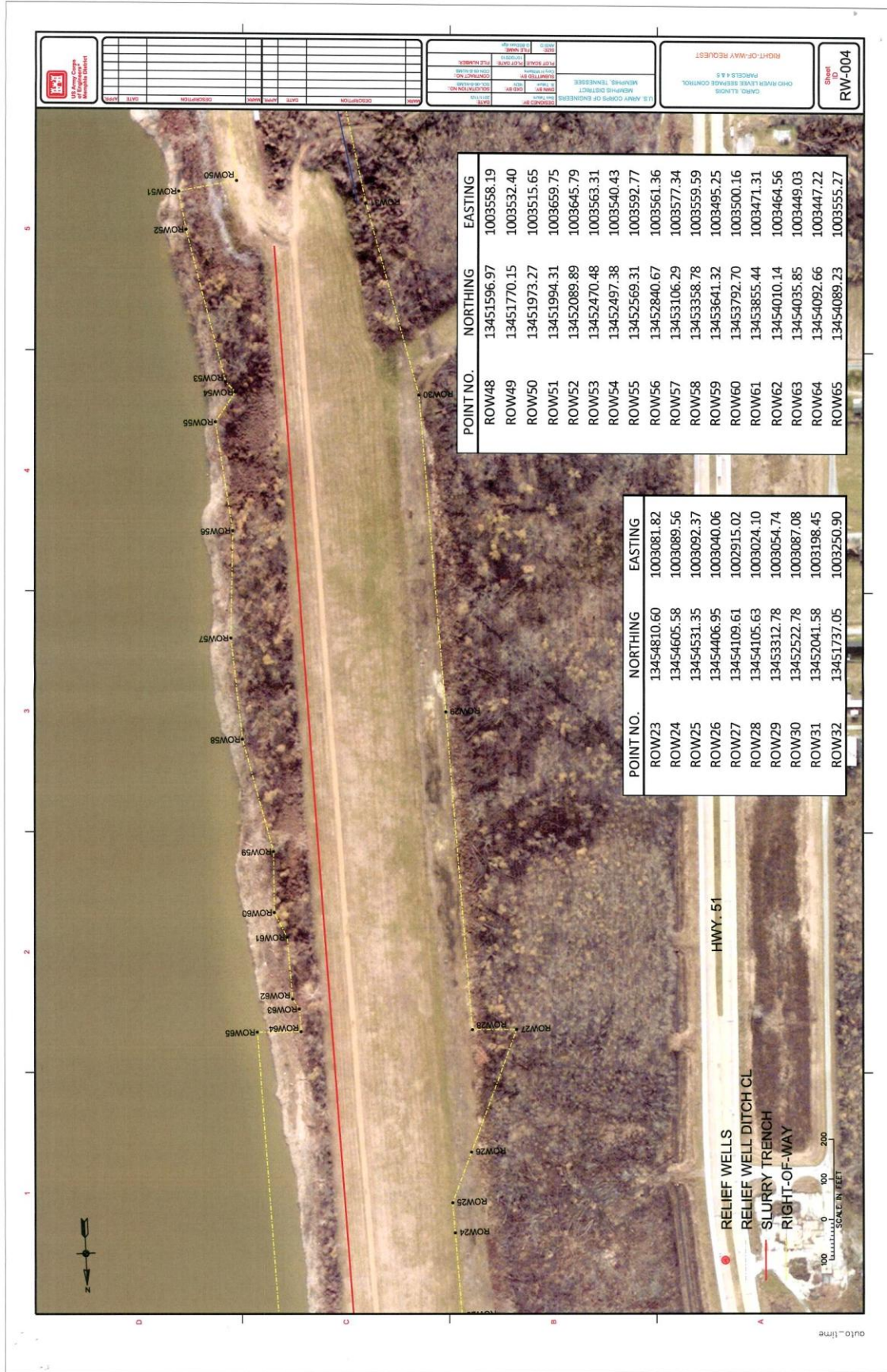




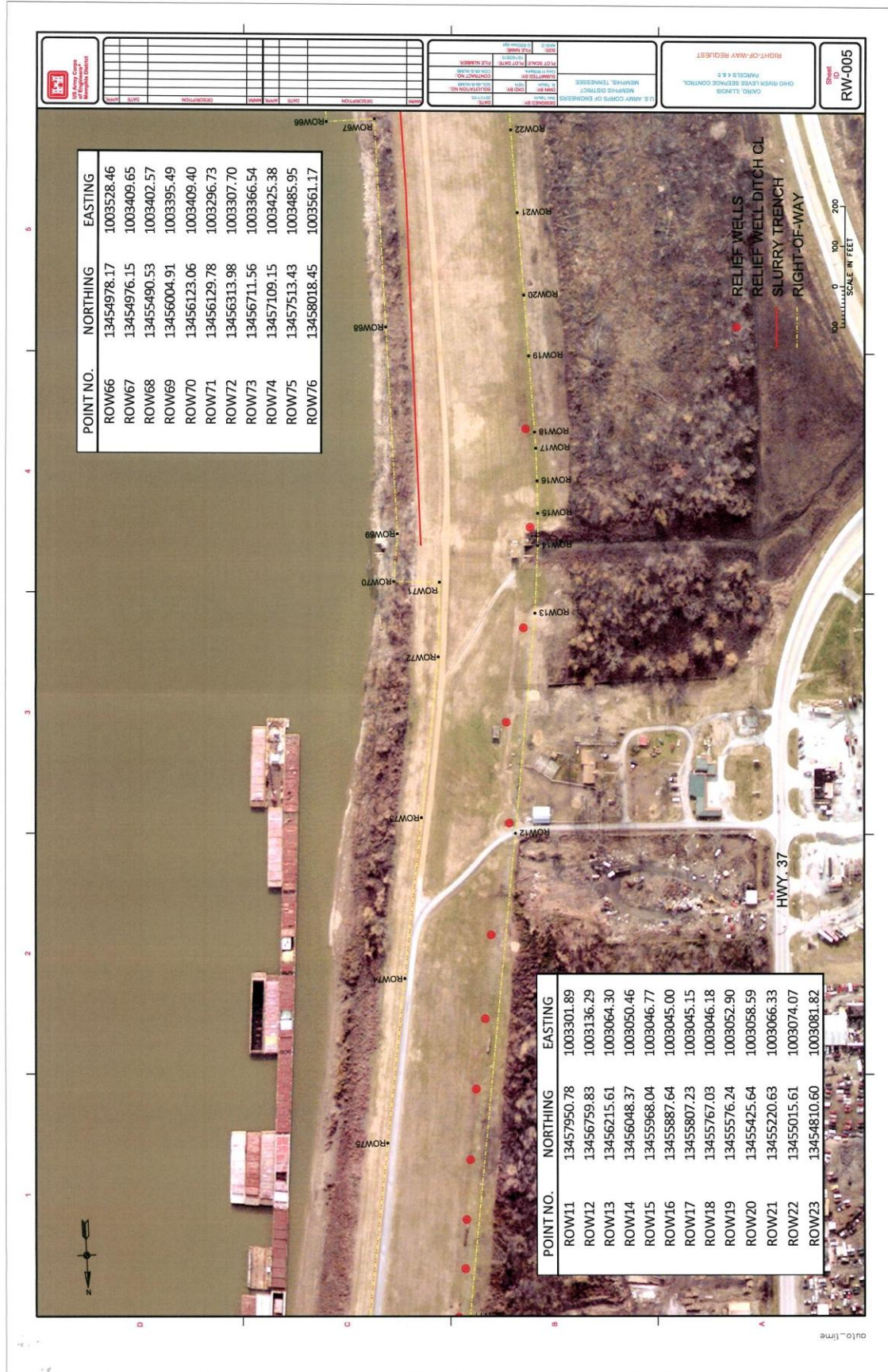




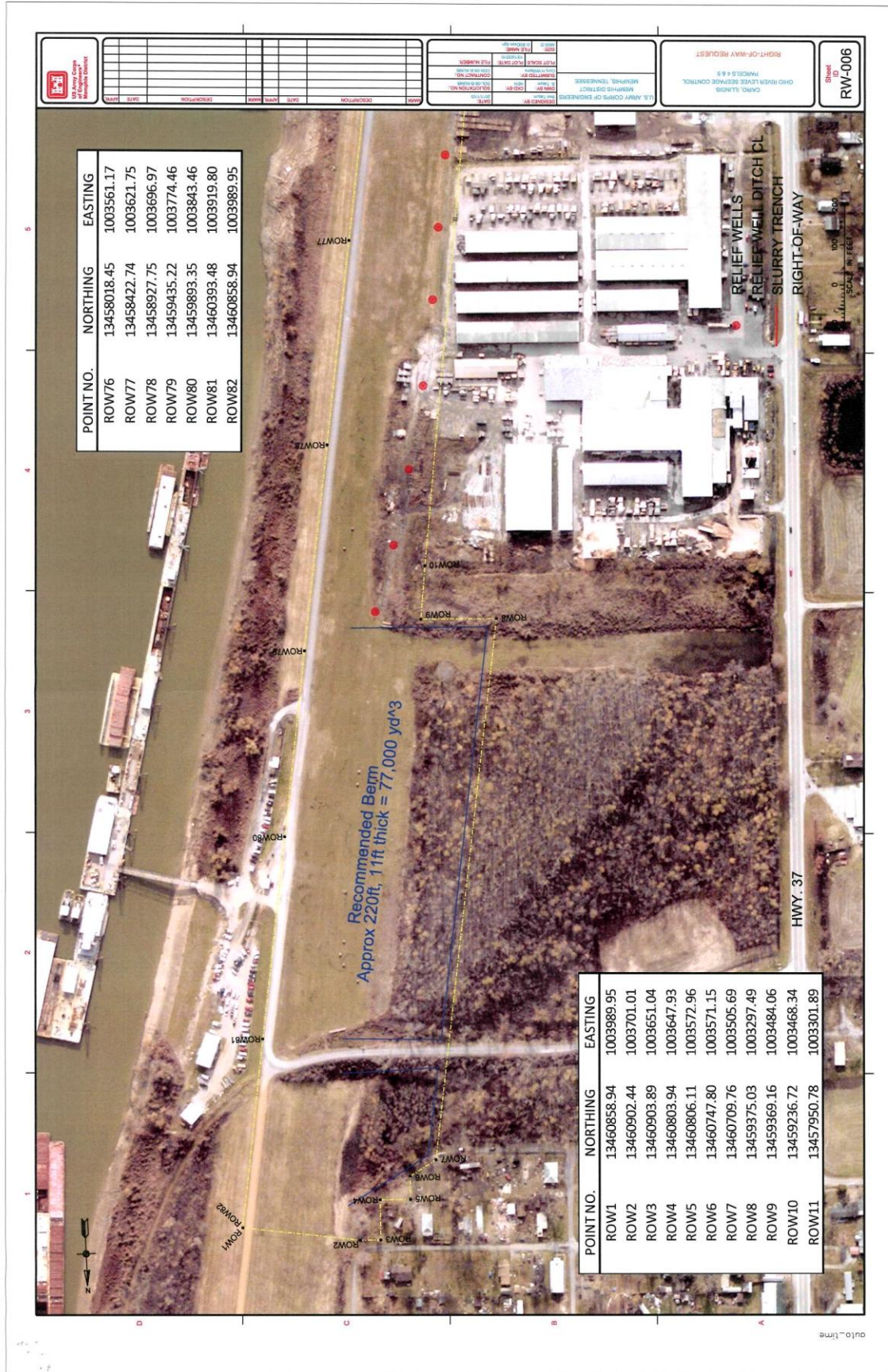




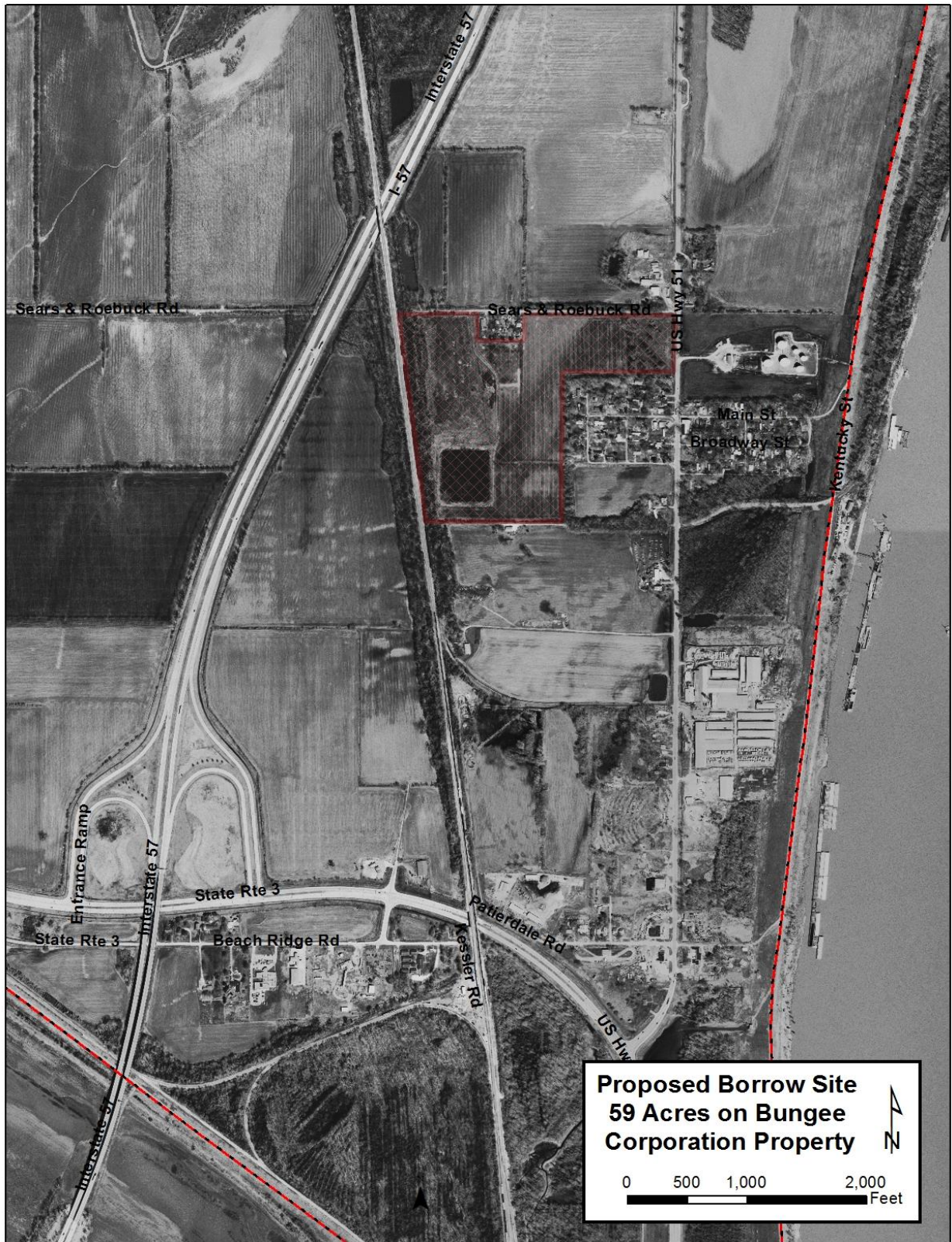














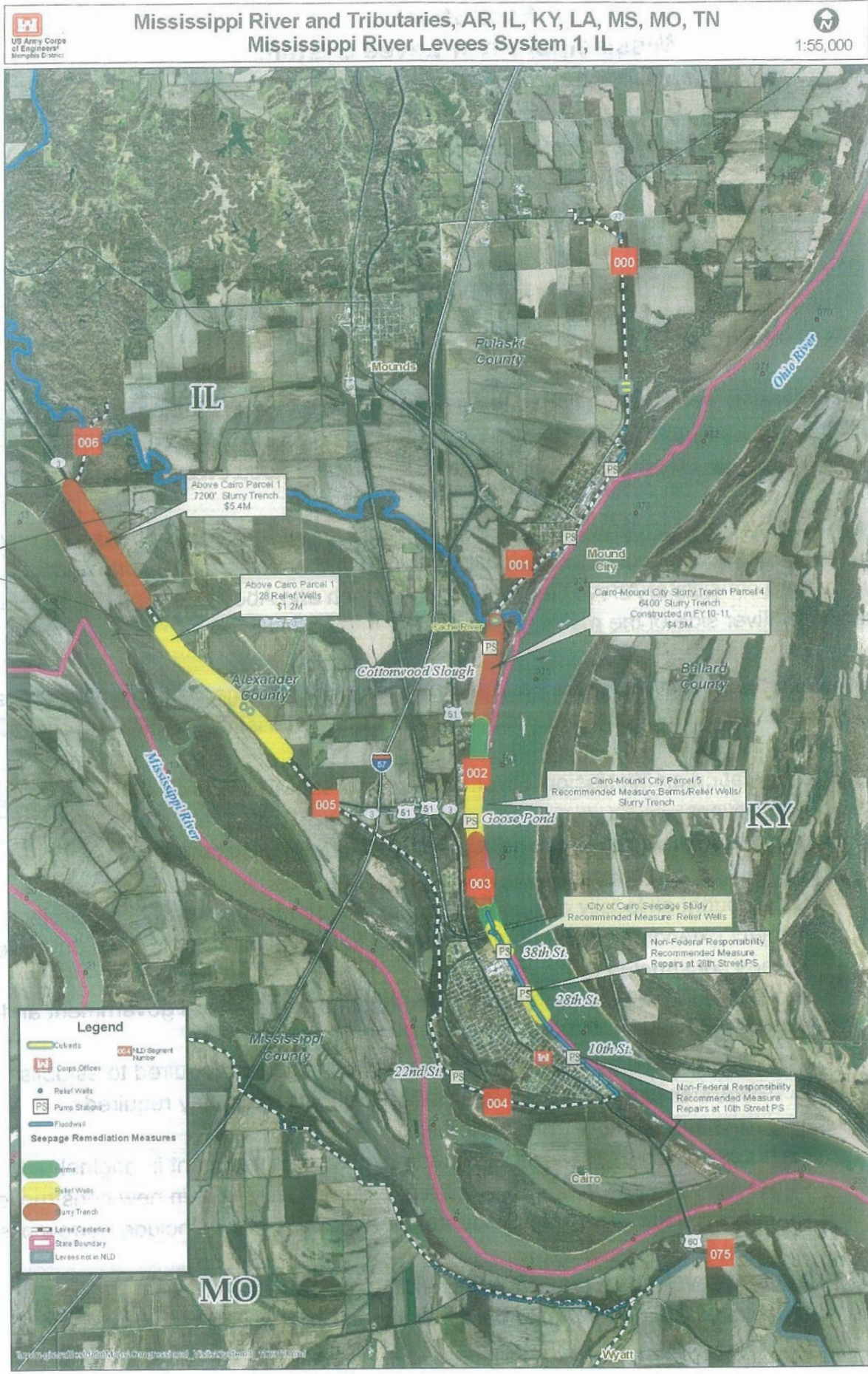
## APPENDIX H

### MISSISSIPPI RIVER LEVEE SYSTEM 1

#### US Army Corps of Engineers, Memphis District Fact Sheet Mississippi River Levee System Southern Illinois – System 1

- System 1 consists of 21.5 miles of levees and floodwalls
- Owned and operated by four local Sponsors
  - Cairo Drainage District
  - City of Cairo
  - Mounds City
  - City of Mounds
- Mississippi River Levees were designed to pass the "Project Design Flood" (PDF).
  - PDF is the maximum flood having a reasonable probability of occurrence
  - System 1 levee heights generally exceed the 100-year flood event by four or more feet
- Construction of System 1 is complete with exception of four underseepage measures having an estimated construction cost of \$20 million; two of the measures are presently under construction and consists of Above Cairo, IL Slurry Trench and Above Cairo, IL Relief Wells on the Mississippi River side of the mainline levee.
- Due to the uncontrolled seepage, the Federal Emergency Management Agency was advised in August 2010 that the system does not meet Corps criteria for passing the 100-year event.
- Background Information on Mississippi River and Tributaries (MR&T) Project, which includes Mississippi River Levees:
  - Original system was built prior to 1900's without Federal assistance
  - Flood of 1927 led to enactment of Flood Control Act (FCA) of 1928
  - FCA 1928 brought all locally owned levees into one comprehensive MR&T Project:
    - Project extends from Illinois and Missouri to Louisiana with almost 3,500 miles of levees constructed
    - Responsibility for the project is shared between the Federal government and Local Sponsors
    - Federal government is responsible for any construction required to establish a consistent level of protection against the PDF, including any required underseepage control measures.
    - Congress recognized locals had made significant investment in original construction and thus does not require locals to cost share in new construction, but does require locals to provide any necessary lands, to include borrow pits, required for construction
    - Federal government responsible for major maintenance.
    - Locals operate and provide routine maintenance





## Cost Estimates for Borrow/ROW and Rehabilitation of Pump Stations In Cairo, IL and Vicinity

### Borrow and ROW Requirements

#### Borrow Requirements

##### North Berm – 77,000 cu yds

Louisiana Dock company LLC	0.02 AC
Illinois DOT	2.47 AC
Alexander County (3 Tracts)	0.40 AC
Williams Jackie D ETUX	1.51 AC
City of Mound City, LA Dock Co LLC	11.03 AC

##### South Berm – 93,000 cu yds

Archer Daniels Midland Co (2 Tracts)	7.17 AC
Shawnee Terminal Railway (2 Tracts)	2.93 AC

Borrow Excavation 20 AC

**Total Borrow Acreage 45.58 AC**

#### Relief Wells North of Slurry Trench (ROW)

Teco Barge Line Cairo DD	8.58 AC
Bunge Sun Industries Inc (2 Tracts)	6.65 AC
Walls Jerry W	

#### Slurry Trench ROW

Cairo Drainage District	11.26 AC
City of Mounds City	8.99 AC
Archer Daniels Midland Co	15.24 AC
Peddie Carol	3.60 AC

#### Relief Wells South of Slurry Trench (ROW)

Unknown (5 Tracts)	1.28 AC
Illinois American Water	0.03 AC
Bunge (4 Tracts)	1.85 AC
City of Cairo	0.07 AC

**Total ROW Acreage 57.55 AC**  
**(Relief Wells and Slurry Trench)**



## Rehabilitation of Pump Stations Requirements

28 <sup>th</sup> Street Pump Station	\$1.5M
Rehab of existing pumps and motors/New Motor Control Center/Rehab Trash Rack/Rehab Large and Small Sluice Gates/Miscellaneous Equipment	
10 <sup>th</sup> Street Pump Station	\$1.5M
Rebuild all pumps/rehab all sluice gates/rehab motorized trash rack/replace Motor Control Center	
Goosepond Pump Station	\$5K
Overhaul or replace manual lubricators	
Cottonwood Slough Pump Station	\$100K
Replace all controls and lubricators	
38 <sup>th</sup> Street Pump Station (City Owned)	\$10K
Overhaul pump by replacing all bearings	
22 <sup>nd</sup> Street Pump Station (City Owned)	\$5k
Clear object from propeller which is preventing pump from working	

**Total Pump Stations Cost**

**\$3.12M**

## APPENDIX I

### AGRICULTURAL DAMAGES

From: **Kujawa, Brandi - FSA, Tamms, IL** <[Brandi.Kujawa@il.usda.gov](mailto:Brandi.Kujawa@il.usda.gov)>

Date: Wed, Mar 7, 2012 at 8:46 AM

Subject: Prevented Planting Acres

To: "[alexcohwy@wildblue.net](mailto:alexcohwy@wildblue.net)" <[alexcohwy@wildblue.net](mailto:alexcohwy@wildblue.net)>

According to what was reported to our office by the producers of Alexander County, there were 19,848 acres that remained unplanted due to the Spring 2011 flood. There were roughly 1,821 acres that were planted and then failed due to the flood.

Hope this helps!

*Brandi Kujawa*

USDA- Farm Service Agency

County Executive Director-Alexander Pulaski